

# Preventing Spread of Infection in School and Daycare



This presentation is adapted from:

Robinson, J. Infectious Diseases: School and  
Child Care Implications. *Pediatrics in  
Review*. 2001;22:39-45

# Introduction

- Due to emergence of resistance, oral antibiotic treatment of bacterial infection acquired from school or daycare is less effective
- The cause of many common illnesses (fever, rashes, URI's) can be determined fairly non-invasively

# Introduction

- Common viral illness (parvovirus, influenza, RSV) spreads among children in school and daycare
- Controlling the spread of illnesses of increasing interest to staff and parents

# Introduction

- Because immunization has reduced serious infection, parents are less willing to see their children acquire these illnesses outside the home



# Epidemiology

# Epidemiology

- Respiratory and diarrheal illness twice as common among preschoolers cared for in daycare centers than those cared for at home
- Children in daycare typically spend the day in a room with 4 to 15 other children
- Many of these children may be asymptomatic yet carry infectious agents in their saliva or feces

# Epidemiology

- Toddlers put either their hands or a toy in their mouths every 3 minutes on average
- Staff have usually received minimal education about the importance of handwashing after diaper changes or before food preparation
- Potty-trained children are rarely supervised to assure handwashing after defecation

# Epidemiology

- By school age, diarrheal and respiratory illness decline
- Some viruses (varicella, EBV) cause more severe disease in adolescents than in younger children



# Epidemiology

- Bacterial illness such as otitis media or meningitis is lower in school age than preschoolers
- Pharyngitis caused by group A beta-hemolytic *Streptococcus* peaks between 5 and 15 years



# Pathogenesis

# Respiratory - Large Droplets

- These infectious agents do not aerosolize
- Spread by direct contact (saliva, nasal secretions, eye discharge)
- Much more likely to spread in a daycare with very young children sharing their toys
- Attack rate in young children is almost 100% whereas older children and adults may be asymptomatic

# Respiratory - Large Droplets

- Viral agents include RSV, adenovirus, parainfluenza, rhinovirus
- Caregivers may be asymptomatic carriers of RSV and may spread illness by touching children after rubbing their own nose or eyes

# Respiratory - Large Droplets

- Bacterial agents include *Streptococcus pneumoniae*, *Haemophilus influenza* (type B and nontypeable), and *Moraxella catarrhalis*
- These agents can be carried in the nasopharynx of asymptomatic children for weeks to months

# Respiratory - Large Droplets

- About 50% of asymptomatic 2-year-olds are carriers of *Streptococcus pneumoniae*
- Carriage rate is highest in children cared for in daycare centers
- Carriage is highest in children with upper respiratory illness
- Carriage rates decrease with age

# Respiratory - Large Droplets

- Most carriers remain symptom-free or develop acute otitis media from the organism they carry
- Invasive disease (bacteremia, pneumonia, meningitis, osteomyelitis) can occur in carriers of *Strep pneumo* or Hib

# Respiratory - Large Droplets

- Carriage with *Neisseria meningitidis* can also be asymptomatic, but can be followed by bacteremia, septic shock, meningitis, or septic arthritis
- Invasive disease from meningococcus is highest in the first few days after colonization



# Respiratory - Large Droplets

- Group A beta-hemolytic *Streptococcus* can be cultured from throats of up to 30% of asymptomatic school age children
- Some children develop Strep throat or impetigo
- More serious pneumonia or necrotizing soft-tissue infections are rare

# Respiratory - Small Droplets

- These infectious agents do aerosolize
- May be airborne over long distances
- These infections are more contagious than infections spread by large droplets

# Respiratory - Small Droplets

- Examples include:

- influenza
- measles
- mumps
- rubella
- varicella

# Respiratory - Small Droplets

- Pulmonary tuberculosis is also spread by small droplets
- Children with pulmonary Tb are rarely contagious because they do not have cavitory disease

# Respiratory - Small Droplets

- *Bordetella pertussis* may also be transmitted by small droplets
- Transmission is most common to people who have been within 5 feet of the infected person

# Enteric Spread

- Diarrheal illness is spread primarily by oral contact with infectious agents from stool
- Fecal flora can often be grown from the hands of daycare workers
- Daycare workers who fail to wash their hands after diaper changes can spread these infections

# Enteric Spread

- Asymptomatic carriage of pathogens such as *Giardia* can persist for months
- Spread of enteric pathogens such as hepatitis A from infected children to daycare staff and parents is well-documented

# Enteric Spread

- Children are at greatest risk of diarrheal illness during the first 4 weeks they spend in daycare
- They may develop some immunity with continued exposure



# Enteric Spread

- Fecal contamination of environmental surfaces (diaper change areas, faucets, floors, toys) probably also plays a role in transmission
- Organisms on surfaces can remain viable for days

# Spread by Other Body Fluids

- HIV, hepatitis B, and Hepatitis C are spread by direct contact with infected blood or sexual contact
- School transmission only likely with sexual contact or illicit drug use
- Spread of HIV or hepatitis C has not been documented in the daycare setting

# Spread by Other Body Fluids

- Spread of hepatitis B can occur if an infected child bites another
- Cytomegalovirus is spread by direct contact with infected urine or saliva
- Child-to-child transmission of CMV occurs primarily among children under 3 years of age

# Spread by Direct Contact

- Head lice are spread by direct contact with infected hair and possibly by fomites (combs or hats)
- Other conditions spread by direct contact:
  - impetigo
  - tinea
  - *Herpes simplex*
  - bacterial conjunctivitis



# Prevention

# Prevention of Large Droplet Spread

- Careful handwashing clearly works
- Difficult to enforce in daycare or school
- Education of daycare providers has not been shown to significantly decrease viral illness
- Ongoing education with surveillance *has* been shown to reduce viral infection
- Surveillance may be a bigger factor than education

# Prevention of Large Droplet Spread

- Handwashing should be encouraged by emphasizing potential benefit to the staff's own health
- Soap, sinks, and towels should be convenient for all

# Prevention of Large Droplet Spread

- Exclusion of symptomatic children is not known to decrease spread of respiratory illness
- Organisms are usually shed before symptoms are apparent
- Children with respiratory illness who feel well enough to attend school or daycare should be allowed to attend



# Prevention of Large Droplet Spread

- Transmission of large droplet bacterial illness is also reduced by handwashing
- Immunization with conjugated vaccines for *Strep pnemo* and Hib reduces both carriage and invasive disease
- Antibiotic prophylaxis is indicated for close contacts of children with invasive meningococcus

# Prevention of Large Droplet Spread

- Antibiotic prophylaxis for GAS exposure is controversial
- Antibiotic prophylaxis for Hib exposure is only indicated if two cases occur within 60 days in a facility where there is incomplete immunization

# Prevention of Large Droplet Spread

- Antibiotic prophylaxis is not indicated for exposure to invasive *Strep pnemo*
- This issue may be need to be re-examined with increasing emergence of resistance

**Table 1. Measures to Decrease Transmission of Infections Spread by Large Respiratory Droplets in a Child Care Center or School**

Organisms	Measures to Decrease Transmission	Level of Evidence*
RSV	• Palivizumab or RSVIG prophylaxis of preterm infants or infants who have chronic lung disease <sup>†</sup>	1
EBV	• No precautions necessary; secondary cases rare and often asymptomatic	3
Parvovirus	• No precautions necessary; not infectious once rash develops	2
<i>S pneumoniae</i> (penicillin-sensitive or PRP)	• Routine immunization of children with conjugated vaccine	1
PRP	• Decreased use of antibiotics in children	2
HIB	• Routine immunization of children	1
	• Antibiotic prophylaxis of contacts if more than two cases within 60 days in a child care facility that has incompletely vaccinated children	2
<i>N meningitidis</i>	• Antibiotic prophylaxis of all contacts in child care facility or of school contacts who have shared secretions in previous 7 days	2
	• Immunization of children >24 months of age in a suspected outbreak with a vaccine-preventable strain	3
GAS	• Antibiotic treatment of carriers who have clinical pharyngitis	3
All organisms listed above plus adenovirus, parainfluenza virus, rhinovirus, <i>H influenzae</i> (nontypeable)	• Handwashing by staff after contacting nasal secretions, saliva, or eye discharge	2
	• Washing of toys	5
	• Decontamination of surfaces	5

\*Level 1—At least one high-quality, randomized, controlled trial had demonstrated efficacy in this age group. The study may have been done in a setting other than a child care center or school. Level 2—Evidence from at least one high-quality study other than a randomized, controlled trial shows that this intervention is or should be effective in this age group. The study may have been done in a setting other than a child care center or school. Level 3—Long-term experience suggests that this intervention is effective in a child care center or school. Level 4—This intervention has not yet been tried, but there is theoretical evidence suggesting efficacy. It is not yet recommended by the American Academy of Pediatrics (AAP). Level 5—This intervention has been recommended but has never been studied except possibly as part of a combined strategy, so the efficacy remains unknown.

<sup>†</sup>Controversial because of the cost.

RSV = respiratory syncytial virus

EBV = Epstein-Barr virus

PRP = penicillin-resistant pneumococci

HIB = *H influenzae* type B

GAS = group A *Streptococcus*

# Prevention of Small Droplet Spread

- Almost all of these diseases can be prevented by immunization
- Insuring that children and staff have received all routine immunization (including varicella) is the most effective tool to prevent spread
- Exclusion of infected children from school or daycare is advised

# Prevention of Small Droplet Spread

- Exclusion of children with chicken pox is controversial
- Varicella virus is shed for at least 24 hours prior to the exantham, thus transmission occurs before recognition of the disease
- Exclusion of children with skin lesions may not alter the course of a school or daycare outbreak



# Prevention of Small Droplet Spread

- The Canadian Pediatric Society allows children with varicella to return to school or daycare as soon as they feel well enough
- Postexposure immunization within 3 days of exposure is more than 90% effective in preventing chicken pox

**Table 2. Measures to Prevent Transmission of Infections Spread by Small Respiratory Droplets in a Child Care Center or School**

Organisms	Measures to Decrease Transmission	Level of Evidence*
Measles	• Routine immunization of children and staff	2
	• Second dose of vaccine to children and staff during an outbreak <sup>†</sup>	5
	• Exclusion of infected children for 6 days after onset of rash	5
Mumps	• Routine immunization of children and staff	2
	• Exclusion of infected children for 9 days after onset of parotitis	5
Rubella	• Routine immunization of children and staff	2
	• Exclusion of infected children for 7 days after onset of rash	5
Varicella	• Routine immunization of children and staff	1
	• Postexposure immunization of nonimmune contacts over 12 months of age <sup>‡</sup>	2
	• Exclusion of infected children until skin lesions crust over (see text)	5
Influenza	• Annual immunization of staff	4
	• Annual immunization of all children <sup>§</sup>	4
	• Chemoprophylaxis of children and staff during an outbreak	4
	• Annual immunization of children who have chronic lung disease, hemodynamically significant heart disease, immunodeficiencies, hemoglobinopathies, or chronic use of ASA	5
<i>B pertussis</i>	• Routine immunization of children	1
	• Exclusion of infected children or staff until on appropriate antibodies for 5 days	2
	• Antibiotic prophylaxis of exposed staff and children in a child care center	2
	• Routine use of acellular pertussis vaccine in adolescents and staff <sup>§</sup>	4
<i>M tuberculosis</i>	• Prompt exclusion of staff or parents who have active pulmonary disease	3
	• TB skin testing of all new staff	5

\*For definitions of levels of evidence, see Table 1.

<sup>†</sup>This is the AAP policy, but rarely should be an issue in countries such as the United States and Canada, which have a two-dose measles vaccine schedule. It has been suggested that immunization of only unvaccinated persons during an outbreak may be more cost-effective.

<sup>‡</sup>The United States is striving to eradicate varicella from schools and child care centers, so postexposure immunization fits with this strategy. Many other developed countries (such as Canada) are moving toward this goal but do not yet have routine varicella immunization, so routine postexposure immunization cannot yet be recommended.

<sup>§</sup>This is not an AAP recommendation but is being tried in some Canadian provinces.



# Prevention of Enteric Spread

- Handwashing
- Developmentally normal children with enteric infections can attend school

# Prevention of Enteric Spread

- Exclusion from daycare would not be necessary if staff and potty-trained children practice adequate handwashing
- Since this cannot always be assured, children suspected of having infectious diarrhea should be excluded from daycare

# Prevention of Enteric Spread

- Asymptomatic carriers have a lower concentration of infectious organisms, thus exclusion is not warranted
- Exceptions:
  - *E. coli* 0157:H7 - because of severe sequelae
  - *Shigella* - because only a small inoculum is needed to spread

# Prevention of Enteric Spread

- Children and staff with hepatitis A should be excluded from school or daycare for 7 days
- Gamma globulin (IG) prophylaxis is not indicated for school contacts unless there are multiple cases

# Prevention of Enteric Spread

- Gamma globulin for hepatitis A prophylaxis is indicated for daycare exposure if the staff and children in the same room as the index case
- If the ill child wears diapers and hepatitis A has spread to a staff member or to two other families in the daycare, all children and staff should get gamma globulin

# Prevention of Enteric Spread

- Hepatitis A vaccine is effective but expensive
- Routine immunization recommended only in areas that have frequent outbreaks

**Table 3. Measures to Prevent Transmission of Infections With Enteric Spread in a Child Care Center or School**

Organisms	Measures to Decrease Transmission	Level of Evidence*
Hepatitis A	• Vaccine prophylaxis of contacts	1
	• IG prophylaxis of contacts (see text)	2
	• Exclusion of infected children or staff for 7 days after onset of illness	5
Non-typhoidal <i>Salmonella</i>	• Exclusion of reptiles from schools and child care facilities	2
<i>E coli</i> 0157:H7, <i>Shigella</i>	• Exclusion of infected children until two stool cultures are negative	3
All of the above organisms plus rotavirus, caliciviruses, enteric adenoviruses, enteroviruses, <sup>†</sup> <i>Camphylobacter jejuni</i> , <i>Cryptosporidium</i> , <i>Giardia lamblia</i> , <i>Enterobius vermicularis</i>	• Handwashing by staff and by toilet-trained children	2
	• Use of cloth diapers only if the water-proof covering is attached to the diaper	2
	• Exclusion of children who have acute diarrhea from child care centers	3
	• Use of small flush toilets rather than potty chairs	5
	• Washing of toys	5
	• Decontamination of surfaces	5
		5
<p>*For definitions of levels of evidence, see Table 1.  <sup>†</sup>Probably also spread by large respiratory droplets.            IG = immune globulin</p>		

# Prevention of Spread from Other Fluids

- If universal precautions are employed, the only risk from infected children is by biting
- Even then, risk of transmission of HIV, hepatitis B, or hepatitis C is extremely low
- Routine screening for these viruses prior to entering school or daycare is not indicated



# Prevention of Spread from Other Fluids

- CMV infection is usually asymptomatic
- Spread among healthy children in daycare is of little concern
- Annual seroconversion rate for parents of children in daycare is 15%
- Thus there is a risk of transmission to a pregnant mother and risk of congenital CMV infection

# Prevention of Spread from Other Fluids

- Pregnant daycare workers have a higher risk of bearing children with congenital CMV than do workers in other professions
- CMV is shed in all body fluids for months to years in asymptomatic children
- It is unlikely that good hygiene can prevent child-to-child spread, but it may help prevent child-to-staff spread

**Table 4. Methods to Prevent Transmission of Infections Spread by Blood or Nonrespiratory Body Secretions**

Virus	Measures to Decrease Transmission	Level of Evidence*
HIV	• Education of adolescents regarding sexually transmitted diseases	5
	• Education of adolescents regarding illicit drug use	5
Hepatitis B	• Routine immunization of children	1
	• Hepatitis B IG and vaccine prophylaxis of children bitten by a carrier	2
	• Education of adolescents regarding sexually transmitted diseases	5
	• Education of adolescents regarding illicit drug use	5
Hepatitis C	• Education of adolescents regarding illicit drug use	5
CMV	• Handwashing by staff	5
<p>*For definitions of levels of evidence, see Table 1.  HIV = human immunodeficiency virus  CMV = cytomegalovirus  IG = immune globulin</p>		

# Prevention of Spread by Direct Contact

- Primary HSV outbreaks (gingivostomatitis) should be excluded from school or daycare
- Subsequent outbreaks of HSV (cold sores) need not be excluded
- Children with lice, scabies, or tinea need only be excluded until treatment is started
- Children with impetigo should be excluded until they receive 24 hours of antibiotics

**Table 5. Methods to Decrease Transmission of Organisms Spread by Direct Contact**

Organisms	Measures to Decrease Transmission	Level of Evidence*
Impetigo	<ul style="list-style-type: none"> <li>• Handwashing by staff</li> <li>• Exclusion of infected children until on antibiotics for 24 h</li> </ul>	3
HSV	<ul style="list-style-type: none"> <li>• Exclusion of preschool children who have primary herpetic gingivostomatitis until lesions crusted over</li> </ul>	5
Scabies	<ul style="list-style-type: none"> <li>• Exclusion of infected children until treatment started</li> </ul>	5
Head lice	<ul style="list-style-type: none"> <li>• Screening of all children in a classroom or child care center and screening of family members of infected children</li> </ul>	5
Tinea	<ul style="list-style-type: none"> <li>• Exclusion of children until treatment started if occurs on scalp (exclusion not as important if occurs elsewhere on body because transmission is less likely)</li> <li>• Avoidance of sharing of combs if occurs on scalp</li> </ul>	5
Purulent conjunctivitis	<ul style="list-style-type: none"> <li>• Exclusion of infected children until treatment started</li> </ul>	3
<p>*For definitions of levels of evidence, see Table 1.            HSV = herpes simplex virus</p>		

# Conclusions

- Effective interventions prevent most serious communicable diseases in school and daycare
- Common minor illnesses continue to be a source of morbidity and inconvenience
- Efforts should target ways of improving hygiene in school and daycare

# Questions?

This presentation is adapted from:  
Robinson, J. Infectious Diseases: School and  
Child Care Implications. *Pediatrics in  
Review*. 2001;22:39-45